



## Edison's Smarter Transmission Grid



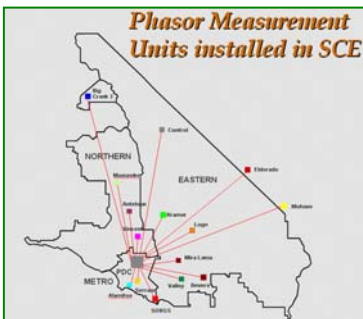
Emerging smart grid technology that Southern California Edison (SCE) engineers played a key role in developing during the past decade that could one day help prevent regional power blackouts such as the Northeast blackout of August 2003 that affected 50 million utility customers in eight states and Canada.

### What Are Phasors and Why Do They Matter?

Power flow limits across transmission lines are based on the phase difference between the 60-cycle voltages at both ends. Measuring these voltage “phasors” in real time allows operators to see and respond to approaching grid stability problems. New technologies pioneered by SCE can alert grid operators to growing phase angle separations in time to take action and avoid the cascading collapse of the grid.

### History

Following a significant disruption in August 1996 of the western states power grid, SCE began researching advanced phasor measurement unit technologies the utility believed had the potential to help prevent reoccurrences. The study was conducted in collaboration with the Western Electricity Coordinating Council (WECC) and the Electric Power Research Institute.



The initial step was monitoring and analyzing WECC system disturbances. To do so, SCE installed phasor measurement units at most of its major 500 kilovolt and 230 kilovolt substations, technology that measures stress in the transmission

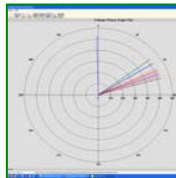
grid based on the angle between the alternating current waveforms. Additionally, the utility began work on an offline analysis tool, which it eventually called Power System Outlook, for planning and operator training. SCE also worked on a real-time operations tool it now calls SCE SMART.

### Power System Outlook

SCE's software program Power System Outlook program was developed in 2000 to help grid operators understand the data the utility was capturing and to synthesize information for engineering and planning purposes.

## SCE Synchronized Measurement and Analysis in Real Time

The next step in the progression of SCE's synchronized phasor measurement system was to develop a real-time tool for system operations and decision making. SCE SMART provides operators and engineers with synchronized data on system stress and stability 30 scans per second. SCE's Grid Control Center currently is using the software to monitor voltage, frequency, power imports and path flows.



SCE SMART also features many of the analytical capabilities of the Power Systems Outlook software, including voltage, currents on monitored circuits, power, reactive power, frequency and frequency deviation, phase angle difference from referenced bus, percent deviation for voltage and current and a voltage phasor display. The program can be used for event recording, continuous data archiving and analyzing power system dynamic behavior. SCE currently is working to incorporate all of the analytical functions of its off-line Power Systems Outlook software into this real-time application.

### Opportunities for Technology Advancement

Although SCE SMART and Power Systems Outlook are highly advanced software packages, they continue to be part of SCE's research, development and demonstration portfolio and are not commercialized products. SCE has freely provided Power Systems Outlook to electric utilities, independent system operators and universities to encourage the development of advanced systems technologies.

### Future Applications

The tools SCE has developed will be used in studies needed to integrate larger amounts of intermittent renewable energy into SCE's grid, such as the 4,500 megawatts of wind generation expected from SCE's Tehachapi Renewable Energy Project. Other future applications will include intelligent control of bulk power components, remedial action schemes, and eventually, closed-loop control.

### What a Smarter Grid Means for Customers

- Enhanced utility service reliability.
- More stable, higher-quality electricity supply.
- Shorter customer outages and faster service restoration.
- A “self-healing” grid.
- New customer program and service options.
- Increased customer control of energy costs.
- Customer connectivity to new “communicating” appliances.